PIXEL SENSOR CELL INCLUDING LIGHT SHIELD

Applicant claims the benefit of Provisional Application Ser. No. 61/158,769, Pixel Sensor Cell Including Light Shield, filed on Mar. 10, 2009.

BACKGROUND

The invention relates generally to pixel sensor cells, methods for fabrication thereof and design structures for fabrication thereof. More particularly, the invention relates to back side illuminated pixel sensor cells intended for use in global shutter mode, with enhanced light shielding.

Solid state sensors are popular optoelectronic components that find use in various technology applications, including in particular imaging technology applications. Particularly common are solid state sensors that are used as active light capture and imaging elements within digital cameras.

Solid state image sensors may be fabricated using any of several semiconductor technologies for the active light capture and imaging elements. Charge coupled devices are known as more traditional solid state image sensor light capture and imaging elements. Complementary metal oxide semiconductor (CMOS) devices provide yet another semiconductor based active light capture and imaging element for use within a solid state image sensor. Solid state image sensors predicated upon CMOS semiconductor devices are generally desirable insofar as such CMOS based solid state image sensors may consume less power in comparison with other types of solid state image sensors.

While solid state image sensors in general, and CMOS image sensors more particularly, are desirable within the optoelectronic component fabrication art, solid state image sensors in general; and CMOS image sensors more particularly, are not entirely without problems. In particular, performance enhancements, such as charge transfer performance enhancements, and spurious light immunity enhancements, are often desirable within solid state sensors in general and solid state image sensors more particularly, in order to assure accurate and timely charge transfer and imaging characteristics.

Two interesting types of CMOS sensors which have seen a lot of attention recently are back side illuminated sensors and global shutter sensors. Back side illuminated sensors receive their light from the bottom or back side of the wafer. For this reason, there is no interference to the incoming light from the metallization which is on top of the silicon. This can yield high quantum efficiency and high angular response. Global shutter image sensors can operate in a mode to expose the entire array simultaneously, thereby eliminating image motion artifacts. In global shutter image sensors, the charge collected in the photodiode in each pixel must be stored on a capacitor within the pixel after the exposure and before the readout. This capacitor must be shielded so that incidental light does not add to the stored charge during the readout time. This is accomplished by a light shield which is usually created by a metal layer above the diffusion connected to or comprising the capacitor, and an electron shield comprised of a potential barrier made by ion implanting dopant underneath the diffusion connected to or comprising the capacitor. The back side illuminated imager technology is not often combined with the global shutter imager technology due to the difficulty of creating a light shield which is effective at preventing back side light from adding to the charge stored on the capacitor.

Various solid state sensor structures and designs, and methods for fabrication thereof, are known in the optoelectronic art.

Foe example, Hawkins, in U.S. Pat. No. 5,244,817, teaches a cost effective method for fabricating a backside image sensor. This particular method may be characterized as a layer transfer method that includes the use of a sacrificial substrate as well as a subsequently affixed carrier substrate.

In addition, Speckbacher et al., in U.S. Pat. No. 5,852,322, teaches another image sensor and method for fabricating the image sensor. This particular image sensor includes backside electrode contacts within the image sensor.

Further, Malinovich et al., in U.S. Pat. No. 6,168,965, teaches an economically manufacturable backside illuminated image sensor. This particular backside illuminated image sensor uses a glass layer lamination method.

Still further, Aebi et al., in U.S. Pat. No. 6,285,018, teaches a pixel sensor cell that allows for low light operation. This particular pixel sensor cell uses a photocathode generated electron bombardment of an active pixel sensor.

Still further, Savoye, in U.S. Pat. No. 6,489,992, teaches a charge coupled device image sensor having a large field of view. This particular image sensor uses a short focal length lens.

Finally, Costello et al., in U.S. Pat. No. 7,005,637, teaches an electron bombardment image sensor with enhanced performance. This particular electron bombardment image sensor uses a selective area backside thinning.

Solid state sensors, including charge coupled device (CCD) image sensors and further including in particular complementary metal oxide semiconductor (CMOS) image sensors, are likely to be of continued interest and continued importance as solid state sensor technology advances. Thus, desirable are solid state sensors, methods for fabrication thereof and design structures for fabrication thereof, as well as related component sub-structures, that provide for improved performance, including image discrimination.

BRIEF SUMMARY

This invention teaches a structure to create a light shield which will work for a back side illuminated imager thus allowing for the creation of a global shutter back side illuminated imager. More particularly, the invention provides a pixel sensor cell, a method for fabricating the pixel sensor cell and a design structure for fabricating the pixel sensor cell. The pixel sensor cell, which includes therein a light blocking layer, typically but not exclusively, comprises a complementary metal oxide semiconductor (CMOS) pixel sensor cell. Within a particular embodiment, the light blocking layer is located interposed between a first semiconductor layer spaced further from a carrier substrate that includes a photoactive region and a second semiconductor layer spaced closer to the carrier substrate that includes at least in-part a second transistor, and preferably also a floating diffusion, that is shielded by the light blocking layer. Within another particular embodiment, the light blocking layer is located to shield, within a dielectric isolated metallization stack, a thin film transistor and a metal-insulator-metal capacitor that are used in place of a floating diffusion within the pixel sensor cell. Within either of the particular embodiments, the light blocking layer avoids spurious light effects within either of the particularly disclosed pixel sensor cells.

A particular pixel sensor cell in accordance with the invention includes a second transistor located within a second semiconductor layer located over a carrier substrate.